

THURSDAY, AUGUST 21, 1884

TECHNICAL INSTRUCTION<sup>1</sup>

## II.

IN a former article the Report of the Royal Commissioners on Technical Education was reviewed so far as relates to the technical schools and colleges of the Continent. The present article deals only with that part of the Report which relates to the United Kingdom.

In the Report of the Royal Commissioners we have a very careful and full account of the various colleges and technical schools that are in existence at the present time. The condition and history of each of these institutions has been thoroughly looked into, and their importance has been fully estimated.

After having passed in review all the important institutions of this kind, the Commissioners devote an exceedingly important part of their Report to conclusions which they have drawn up from the facts placed before them in their various inquiries.

The early part of this chapter is devoted to comparing the development of the various industries both at home and abroad. The fact is pointed out that we were practically the sole possessors of modern appliances until the early part of the present reign, when the Continental nations, settling down to peace after troubled times, found that to compete in any way with us they must give every facility to the then rising generation to improve their position. For this purpose, as was shown in the previous article, technical or polytechnic schools were instituted in most of the Continental States. It is within this period that most of our present institutions for technical education have sprung into existence; but now, on all hands, we find that the advantages obtained from these are acknowledged both by those who directly benefit by their teaching and by manufacturers, who are able to advance the perfection of their products through the higher state of education of those serving under them.

One great aim of the Technical Commissioners has been to examine into the condition and systems of working of these institutes, and in this point they have to be congratulated upon the care and thoroughness with which they have sought and grappled with the weak points of the present system of education. Not only have the Technical Commissioners so carefully considered the defects in our system of education, but they have just as laboriously and skilfully offered suggestions and made recommendations of reform which it is only right that the nation should insist on being carried out.

One of the first weak points noticed is that almost all the colleges and technical schools stand in need of funds to enable them to cope with the demand made upon them for larger teaching staffs, greater accommodation, and better equipment in their art departments, laboratories, and workshops. Another great need that is pointed out, is the non-existence of modern secondary schools, which are necessary to give a preliminary training to students before entering one of the higher colleges or technical schools, where they can continue their study side by side

with their practical work. In this case the Commissioners are of opinion that this, the greatest defect of our system, should be made a matter of legislation, and that local governing bodies should be empowered to found technical and secondary schools wherever necessary.

In discussing the value of the existing colleges the Technical Commissioners remark that "It is most praiseworthy on the part of the professors and teachers that they devote themselves to the important work of tuition for salaries so small as those which they as a rule receive, when many would, by employing their scientific and technical knowledge in private enterprise, obtain much larger pecuniary remuneration." This is of course a fact due in most cases to the lack of funds in such institutions, and in all probability would be considerably remedied if they were relieved from this trouble.

Again, in discussing this same question the Commissioners are of opinion that all colleges do not need to be of the highest type, but of those that are, they say:—"It is, however, of national importance that these few should be placed in such a position of efficiency as to enable them to carry out successfully the highest educational work in the special direction for which the circumstances, particularly of locality, have fitted them; your Commissioners believe that no portion of the national expenditure on education is of greater importance than that employed in the scientific culture of the leaders of industry." Surely the Commissioners could not have spoken plainer. They have without doubt placed on record the fact that such colleges are necessary for the increase of education; and that as yet they are not sufficiently well supported to carry on the duties intrusted to them to their fullest extent.

Two points are well worthy of note in reference to instruction in elementary schools. The Commissioners call attention to the fact that on the Continent *drawing* is an obligatory subject and is held as of equal importance with writing; this is a point which seems to have impressed them, because they are of opinion that "instruction in the rudiments of drawing should be incorporated with writing." This is a point referred to repeatedly in the Report, and great importance is attached to it, as will be seen by the recommendations quoted below.

The second point is the employment of a special science teacher, as at Liverpool and Birmingham, who devotes his time to going round to the various schools giving sound scientific instruction; each lesson being repeated during the week by the schoolmaster.

The whole Report is one mass of useful information, and the suggestions and recommendations which it contains are very valuable. The following are among the most important recommendations quoted at the close of the Report:—

I. As to public elementary schools:—(a) That rudimentary drawing be incorporated with writing as a single elementary subject, and that instruction in elementary drawing be continued throughout the standards. That the inspectors of the Education Department, Whitehall, be responsible for the instruction in drawing. That drawing from casts and models be required as part of the work, and that modelling be encouraged by grant. (c) That, after reasonable notice, a school shall not be deemed provided with proper "apparatus of elementary

<sup>1</sup> Continued from p. 358.

instruction," under Art. 115 of the Code, unless it have a proper supply of casts and models for drawing.

II. As to classes under the Science and Art Department, and grants by the Department :—(a) That school boards have power to establish, conduct, and contribute to the maintenance of classes for young persons and adults (being artisans) under the Science and Art Department. That, in localities having no school board, the local authority have analogous powers.

IV. Secondary and technical instruction :—(a) That steps be taken to accelerate the application of ancient endowments, under amended schemes, to secondary and technical instruction. (b) That provision be made by the Charity Commissioners for the establishment, in suitable localities, of schools or departments of schools in which the study of natural science, drawing, mathematics, and modern languages shall take the place of Latin and Greek. (c) That local authorities be empowered, if they think fit, to establish, maintain, and contribute to the establishment and maintenance of secondary and technical (including agricultural) schools and colleges.

V. Public libraries and museums :—(b) That museums of art and science and technological collections be open to the public on Sundays.

#### COTTERILL'S "APPLIED MECHANICS"

*Applied Mechanics: an Elementary General Introduction to the Theory of Structures and Machines.* By James H. Cotterill, F.R.S. (London: Macmillan and Co., 1884.)

AMONG the many indications of the increasing interest which technical education, in its widest extent, now calls forth, one of the most conspicuous is the production of manuals and text-books on the various subjects with which it deals. Amongst these there is none which is more important than *Applied Mechanics*, and, at the same time, we may add that there is none which has been more in need of a good elementary text-book. The great works on the subject by Rankine and Moseley are not adapted for elementary teaching, involving mathematical processes beyond the power of a beginner, and thus it has come to pass that a country renowned for its engineering triumphs and for the excellence of many treatises dealing with the practical applications of applied mechanics, has hitherto possessed no book devoted to an exposition of its principles and suitable for educational purposes. Those persons, therefore, who are familiar with Prof. Cotterill's work on the Steam-Engine will have looked forward with much interest to the publication of his long-advertised book on "*Applied Mechanics*." Its recent appearance we venture to think has in no sense disappointed their expectation, for it bears on every page evidence that its author has not only studied and become intimately acquainted with his subject, but that he possesses the rare faculty of having learned by experience in teaching, the best way of presenting a subject so as to diminish its difficulties and make rough places smooth for the footsteps of the beginner. By assuming a knowledge on the part of the reader of the elements of theoretical mechanics he has been enabled to devote the whole of this large volume to the exposition of the more complicated science, in which

the principles of the former are applied to the problems of construction presented to the architect and the engineer. The treatise is strictly elementary in its methods, the mathematics used being, almost without exception, of the simplest kind, and many results, which have usually been obtained by complicated investigations, are here arrived at by neat and elegant simple processes. The style of reasoning adopted is also very successful, being neither too diffuse, nor, on the other hand, so much compressed as to puzzle and dishearten the beginner by gaps in the reasoning which his mental capacity is not able to bridge. This is particularly evident in the earlier parts of the book. Towards the end, in the section on Hydraulics and Pneumatics, we think that sufficient fulness of explanation has hardly been furnished, in dealing with the application of the principles of Energy, Momentum and Moment of Momentum, to Fluids, and especially in the case of Hydraulic Motors, to enable the student to grasp the subject without a frequent reference to some of the text-books which the author names.

Another point of supreme importance in which Prof. Cotterill's treatment leaves nothing to be desired, is the manner in which he has attained the aim he set before himself of endeavouring "to distinguish as clearly as possible between those parts of the subject which are universally and necessarily true, and those parts which rest on hypotheses more or less questionable." In *Applied Mechanics* it frequently, we may say usually, happens that, owing to various disturbing causes, exact investigations are either impossible to effect or useless from a practical point of view when carried out, owing to the complexity of the results, and we are therefore led either to adopt results derived from experiments conducted under the guidance of a roughly approximate theory or obliged to rely on experiment alone and, in studying the subject, it is of prime importance that the exact limitations should be stated under which the formulæ and rules given can with certainty be applied. This exact knowledge is necessary not only in the interests of science, but also in many practical applications involving the security of life or property. Many writers on this subject have slurred over or insufficiently estimated the importance of an exact statement of conditions and limitations, and consequently we are glad to recognise and point out the thorough and satisfactory way in which this has been attended to by the author.

The book is divided into five parts, of which the first is devoted to "The Statics of Structures." In this section there is not room in an elementary work for much new matter, but we may point out as specially good the manner in which the communication of stress from part to part of a compound frame is traced out. The relation and interdependence of the primary and secondary trusses of such a structure is here indicated more clearly than in any work with which we are acquainted.

The principal peculiarity of the book consists in the complete adoption of Reuleaux's Kinematic Analysis as the basis of the description and treatment of machines, both in their kinematic and kinetic aspects. In this system a machine is regarded as consisting "of a number of parts so connected together as to be capable of moving relatively to one another in a way completely defined by the nature of the machine. Each part forms an element